TECHNOLOGY DEPT.

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. LIII
No. 1377

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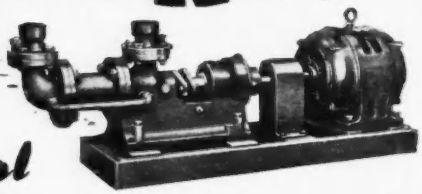
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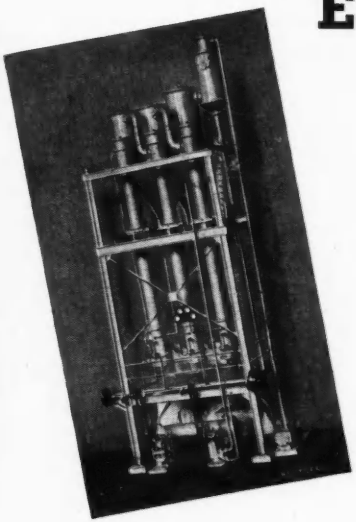
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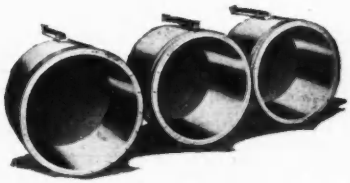
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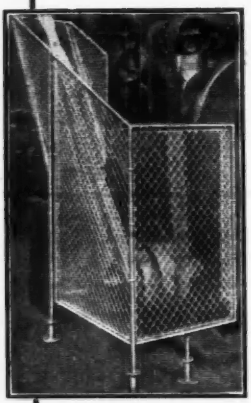
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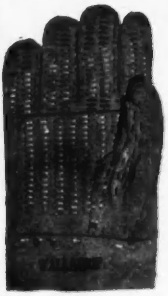
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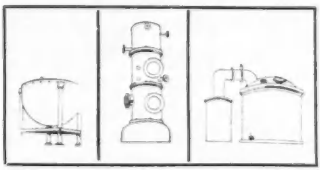


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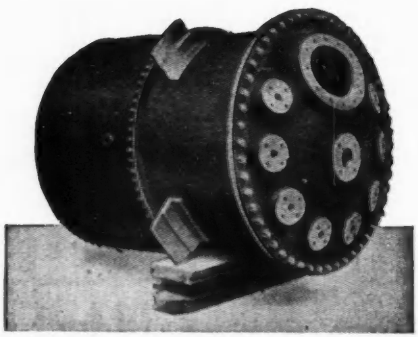
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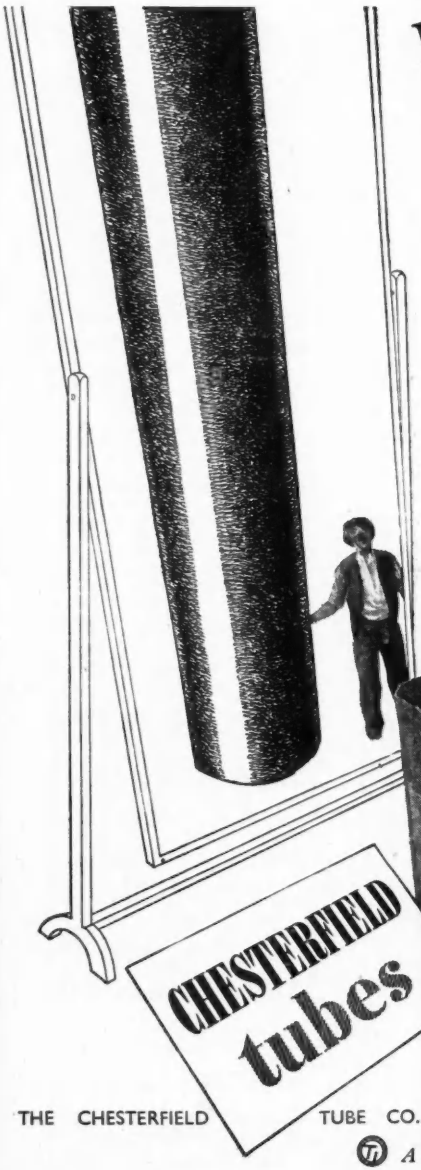
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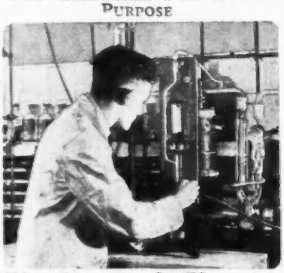
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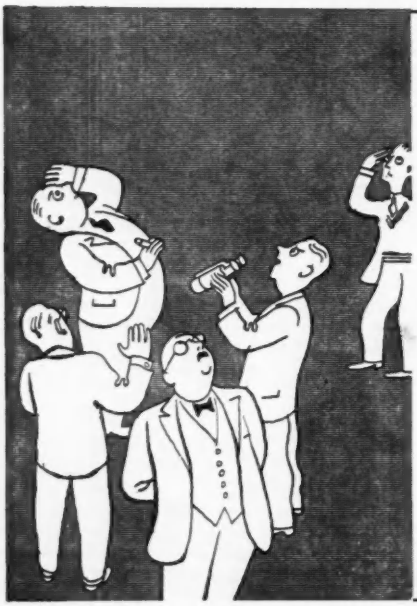
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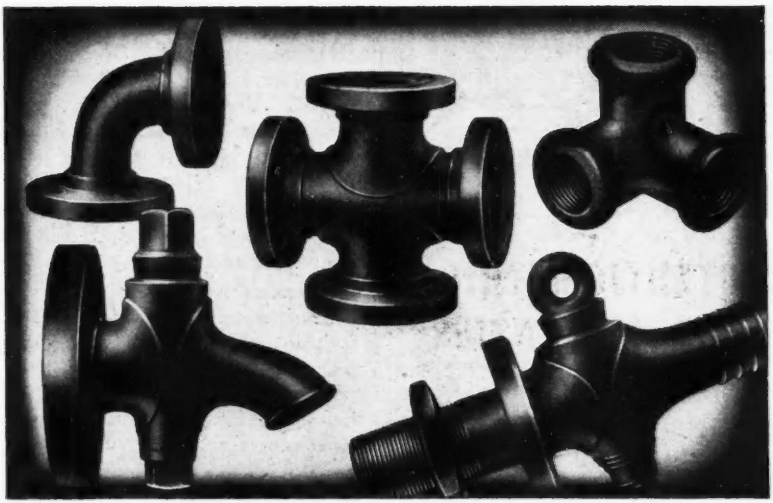
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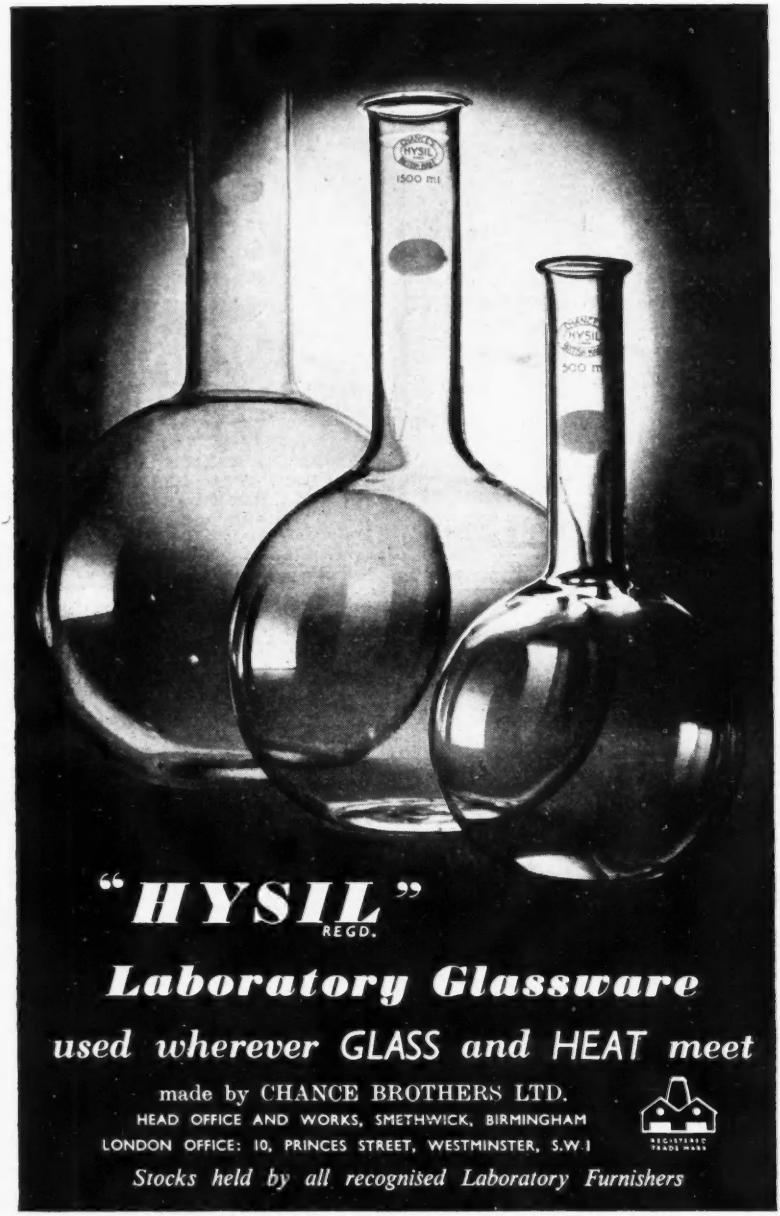
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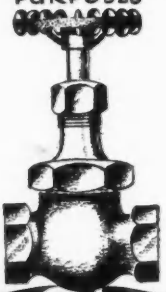
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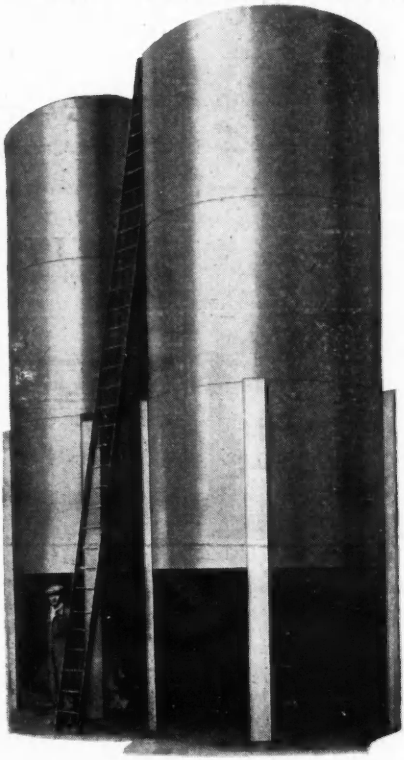
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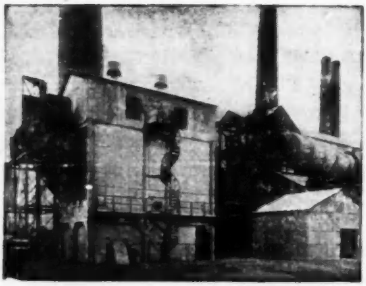
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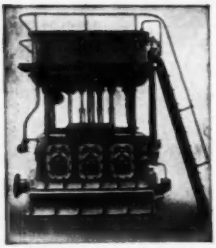
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VOL. LIII No. 1377. — November 17, 1945 — Annual Subscription 21s. Overseas 26s.

Technical Education

IT is rare for a report to contain so much material of first rate importance as that issued on Higher Technological Education by the committee under the chairmanship of Lord Eustace Percy. Almost every paragraph could be made the theme of a discussion that would take all the space we have available. That being so, we shall not attempt to discuss it *in extenso*, but rather to give a general appraisal of its contents. To readers of THE CHEMICAL AGE, it would be preaching to the converted to point out that this nation must for the future exist primarily by the skill and brains that are applied to industry. Whatever may be the future set-up of British industry in the reorganisation that is now in progress, two things are certain: one is that the best brains of the country must be attracted into industry; the other is that those brains must retain freedom of action and must be given adequate spur for initiative and enterprise. Brains without enterprise are worthless. Fortunately, the Government already recognises that, in the words of Mr. Herbert Morrison, "we can only build social security on industrial efficiency." Whether the present state of nationalisation will also give scope for enterprise remains to be seen. At least it seems to be recognised in the highest quarters that the technical man is about to come into his own.

In all industries there is a cry for more technical men. It has been pointed out that in this country our universities and colleges are now turning out about 50 chemical engineers a year (who are distributed over the whole of the industry); in the U.S.A., with a population about three times ours, the figure is 2000 to 3000 men per annum. For the proper provision of chemical engineers in this country we should have 800 new entrants a year. The same sort of problem faces other industries. Why do we not get the entrants? This is the sort of problem which the Percy Committee has had to face, and it recognises that more and better students must be attracted to our universities and technical colleges. The report hardly answers the question "Why"?, and until that question is answered there will be difficulty in attracting the right men in the requisite numbers.

The report indicates that there is "urgent need for a national campaign to increase the prestige

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of the technical professions and to counteract the impression that the road to responsible executive posts in industry does not lie through those professions. It is later pointed out that "the highly trained technician is often ignorant of the principles of industrial organisation and management and . . . often shows no inclination to accept administrative responsibility." It may be true that there are academically-minded men who are content to go through life grappling with technical and scientific problems and without any desire to undertake the responsibilities of management. One reason for this is that scientific and technical work is in itself extraordinarily fascinating and those who are called to undertake management and administrative work generally realise with a pang that it means giving up the most interesting part of their work.

An eminent chemist who is now managing director of his firm put it to us this way: "The time comes when a man has to look after his family and to make some money; when that time comes he has to give up chemistry and take to commerce." Is not that in a nutshell half the reason why the best brains are not attracted to industry on the technical side? The commercial and administrative staff is paid more than the technical staff and not infrequently has a higher status. A young man of enterprise and with an independent turn of mind is naturally not attracted under conditions in which he finds himself regarded as inferior to the commercial men of the same status. The way to attract more technical entrants of the right calibre into industry is to make technical posts more attractive. That is not a problem in education, nor is it a problem for the Percy Committee. It is an administrative problem that industry must solve for itself. Until it is solved the result must continue to be unsatisfactory.

Another difficulty in attracting good brains into industry is financial. The Percy report hardly touches on this except by implication when it adds its voice to those who are pleading for more Government bursaries. The majority of young men cannot afford to go to a university. Very often their parents cannot afford to keep them even if the majority of the university expenses are paid by grant. There are many who do find no urge for learning when the time comes to leave school and who like to go into the works. When, later, the necessity for further education dawns upon them they find that they have burnt their boats and there is no road back, the fundamental impediment being financial. The Percy report is greatly concerned to find a road back and quite rightly maintains that this road should not be that of evening classes. The report states: "For the best of such early recruits, at least, there should be a recognised path back to full-time education through the part-time courses of technical colleges. For some, this path will lead to Colleges of Technology or to other technical institutions; for some it should lead to the university." It is widely urged that industry must itself take a hand in technical education. "Industry itself does something in this field, and might do more; but the State should do much more. Unless it does so, the whole idea of full-time or semi-full-time courses in Colleges of Technology must break down. We hope that the State, having discovered during the war that special bursaries and cadetships can attract a new supply of able students, will not neglect to apply that experience to the hardly less urgent problems of peace."

The Committee has perceived the need for technical training as distinct from academic training and in order to promote this objective it has made the following recommendations: Eight Regional Advisory Councils should be established in England and Wales to co-ordinate technological studies in all grades of technical institution. Each council should establish an academic board to ensure co-ordination on the teaching level and there should be arrangements for adequate representation of and consultation with industry on both the council and the board. The Minister of Education should establish a standing organisation, to be known as the National Council of Technology, to advise on national aspects of regional policy. A limited number of colleges should be selected as Colleges of Technology to provide full-time courses, as well as facilities for post-graduate

studies. For engineering, about six colleges are suggested, excluding the London area; others might be selected for other branches of technology. These proposals set up a new type of training college and in our opinion will provide machinery through which industry can be supplied with senior and intermediate technical men. Special training for administration still appears necessary—it may well be provided by the Staff Colleges mentioned below—and industry must itself select likely candidates for further training, to be effected by means of intensive courses which may be taken at any age.

The report is a courageous attempt to suggest an organisation of higher technological education which will be more responsive and adaptable to the needs of industry than the present system. Its recommendations would provide the machinery for education, but it seems to us to leave unsolved the problem of how it may be made possible for students to take advantage of it.

NOTES AND COMMENTS

Training Business Leaders

THE high degree of training available to scientists and technologists has not hitherto been matched on the administrative side of British industry. Great interest therefore attaches to the news that an Administrative Staff college is to be founded, where men and women holding senior positions in industry, commerce, finance, the Civil Service, trade unions, and social work will be able to attend courses. The syllabus will normally be of three months' duration, and will provide opportunity for study, reflection, and "comparing notes." During a period in which industry and government are forming new relationships, partly as the outcome of the war and partly as a result of political trends, the new college will serve a useful purpose if it helps to dispel suspicion and foster mutual understanding. Most Government officials are still ignorant of the factors that determine commercial practice, while business men are not much better informed of the inner workings of the Civil Service. The inclusion of trade unionists and voluntary social workers within the scope of the scheme is another valuable aspect.

An American Suggestion

DOUBTLESS some business men will regard the new college with misgiving; any form of training is still apt to be suspect by those who learnt their trade by rule of thumb. We are therefore interested to read that the need of better administration in industry is now recognised even in America, still the home *par excellence* of individual enterprise. Addressing students at Princeton University, the Assistant Secretary of the U.S. Navy recently suggested that senior executives in business and Government departments should actually exchange places for short periods of duty. This, he believed, would provide an insight into mutual points of view with resultant advantages to all concerned. British business men who are still struggling with Government controls would hardly welcome such a spell of "office"—they might prefer to abolish Whitehall!—but it would undoubtedly help if some of our civil servants could see at first hand the burden imposed by their rules and regulations on the day-to-day workings of business. There is clearly a great chance for the new Administrative College to bring fresh insight to bear on the problems of post-war industry. Its sponsors include Mr. Geoffrey Heyworth, the chairman of Unilever, whose views on the need of training for international trade we commented upon last week.

Fire without Smoke

REAL progress is being made in the campaign for smoke abatement. At the conference on post-war planning held on November 8 at the Civic Centre, Southampton, three important papers were presented on various aspects of the subject; and these were followed up by a joint meeting in Manchester, at the Engineers' Club, in which the Institute of Fuel combined with the National Smoke Abatement Society in a discussion on Domestic Fuel Efficiency and Smoke Production. Three more papers of the

highest value were read here, and, from the technical man's point of view, the last of the three, on "The Provision of Smokeless Fuels," by Dr. G. E. Foxwell, was of the greatest importance. It is especially interesting to note that the same authority is to read a paper on Fuel Utilisation generally at the Institute of Fuel's Glasgow meeting on November 30; and it is not stretching the imagination very far to suggest that this paper will give the fullest consideration to every aspect of the subject. It is, indeed, high time that the proper use of fuel, with the concomitant attainment of smokeless air, took a more prominent place in the minds of the people of this country, for, as Major Markham said at Southampton, "The loss to British industry and trade through man-made fog has been assessed at a staggering figure," not to speak of the heavy toll in "dirt, disease, death, and lost aesthetic values." The chemical industry, also, is well aware of the valuable products that can become available to it if our coal is properly processed.

Pyrenean Petrol

GREAT hopes were raised in France round about 1939 that a plentiful source of subterranean oil existed in the neighbourhood of the town of Saint-Gaudens, in the foothills of the Pyrenees. Trial borings tapped a pocket of petroleum-bearing gas at a depth of 4500 feet, and a baseless rumour was circulated that British, American, and Russian syndicates were seeking shares in the exploitation of this hidden wealth. In the following year, however, a German company, Kontinental-Oel, was granted exploration rights by the Vichy Minister of Production, and boring equipment on a considerable scale was transported to the site. Before it could be used, however, the Germans were obliged to quit, and several thousand yards of steel pipework still remain in the goods-yard at Saint-Gaudens. The actual facts are these. After a promising start in 1940, when a limited supply of oil of excellent quality, resembling the Pennsylvania petroleums in composition, was obtained, many more borings were sunk, but up to the present no more oil has been struck; in compensation, however, a steady supply of natural gas has been maintained. This is notably rich in butane, and provides about 500 tons a month of light fuel oil, which is extracted in the refinery at Saint-Marcet, a few miles north of Saint-Gaudens. To-day, six gas wells are in operation, most of them producing over 200,000 cu. m. per day of a gas of high calorific value, reckoned at about three times that of town gas. The gas is dried and piped to Saint-Gaudens and Toulouse, where it is used for both heating and (when compressed) for propulsion, and an extension of the pipe-line to Tarbes is under construction. An oil engineer estimates the daily saving effected to be equivalent to 46,000 litres of petrol and 315 tons of coal, a reasonably important contribution to the local economy.

X-Ray Jubilee

IT is a sad reflection, indeed, on the perversion and decline of German science that the most elaborate Jubilee celebration of Röntgen's discovery of X-Rays on November 8, 1895, should have been staged in Britain. Many learned societies have honoured the occasion; and the Royal Society convened a meeting on Thursday last week at Burlington House, which was attended by many distinguished scientists, including a number of guests from overseas. On this occasion the President recounted reminiscences of his Cambridge days, when Röntgen's discovery first became known in this country and (as is so often the case) was received with almost universal incredulity—except by "J.J." Sir Henry Dale made the complimentary comment that Röntgen's far-reaching discovery was "the result of a happy accident, which happens to the man who deserves it." The President was followed by an illuminating speech from Sir Lawrence Bragg, who said that it was amazing how many things Röntgen had realised (considering the state of science at that time) when he presented his famous paper at Würzburg. Since then X-rays have become indispensable in almost every branch of science, notably in medicine, while playing, more recently, an ever-increasing rôle in industry.

Patent Policy in the United States

Possible Effects on British-Owned Patents

by S. MITTLER, A.F.R.Ae.S., A.M.I.Mech.E.

ATTENTION has been focussed on the trend of patent policy in the United States by the publication of the agenda for the staff of a new Committee on the Patent System, which has been set up by President Truman, to work under Mr. Secretary Wallace, with Mr. William H. Davis as chairman.

Taken as a whole, the programme set out in the agenda appears to be a revolution in the U.S. patent system. A closer analysis, however, shows that many of its points are more or less the absorption of ideas which have been practised in this country and on the European Continent for some time.

The publication of the agenda was preceded by the Report of the Temporary National Economic Committee (T.N.E.C.) in 1938, and by that of the National Patent Planning Commission (N.P.P.C.) in 1943, and by decisions of the Supreme Court and of Lower Courts.

Among the new committee's objectives is the setting up of a "comprehensive public register of science as applied to the useful arts." This is by no means a new departure: every patent library has to serve this purpose, for it is the publication of the invention in return for which the patentee is granted a temporary monopoly. If the efficiency of the U.S. Patent Register and Library is improved by the new committee, and an example is thereby set to the corresponding institutions of other countries, inventors, industry, and the public alike will benefit.

The "Flash of Genius"

This point of the agenda has been foreshadowed by some of the above-mentioned legal decisions. The leading case is *Cuno v. Automatic* (314 U.S. 84, 1942, CD 723), where the Supreme Court (Justice Douglas) denied infringement of a patent because its subject matter did not show "the flash of creative genius," but "merely the skill of the calling," and hence "has not established its right to a private grant on the public domain." This case unleashed a flood of comments; for example, a leading periodical of the American patent profession, the *Journal of the Patent Office Society*, published a special "Flash of Genius" issue in November, 1943, and many articles on this subject in other issue.

It appears, however, that the importance of this decision was considerably overestimated. The decision of a lower court, the Court of Customs and Patent Appeals, *in re Shortell*, April 4, 1944 (565 O.G. 526, 142 F (2d.) 292, 61 USPQ 362), attributed to Judge Lenroot, since retired, says that the "Flash of Genius" expression in the above case merely emphasises the well-known requirement for patentability "that a process performed, or a thing produced, must not be obvious to one skilled in the art." Another point in this remarkable decision is "that new standards should not be created by the Lower Courts, but should be left to the legislation by Congress."

The introduction of a legal definition of invention, on the basis of the decisions of the Supreme Court since 1930, is on the new committee's agenda. Such definition was repeatedly attempted at the end of the 19th century, when patent legislation was introduced in various European countries, and was always given up as impossible. It does not show much confidence in the feasibility of such a definition, that the splitting up of inventions into different grades, each with its standard of inventiveness of its own, is an alternative consideration before the new Committee. Incidentally, such a step would follow to some extent the example of the German *Gebrauchsmuster* (utility model).

Two Grades of Patent

The introduction of two different grades of patent might have some repercussions on the position of British patentees, whose U.S. patent applications are based on patent applications acceptable to the British Patent Office. The practice of the U.S. Patent Office is already much more severe than that of the British Patent Office. The Comptroller, or the British Appeal Tribunal, in case of doubt of the inventiveness of a patent application, use their discretion in favour of the applicant, based on the consideration that a refusal to seal the patent would be final, while the validity of a patent, when granted, is still open to revision by petition for revocation to the Court (Section 25, Patents and Designs Act, 1907-1942), when the Court of Appeal and, if leave is given, the House of Lords, are available for appeal to the patentee and the petitioner alike.

According to S. Spintman (*J. Pat. Off Soc.*, 1945, p. 422), there is no difference between the principles applied by the U.S. Patent Office and the Courts. However, while in the source of official examination a single examiner can devote a few hours to the examination of an invention forming the subject matter of a patent application, a host of investigators is combing the patent libraries all the world over for weeks or

even months in search of prior art affecting the validity of a patent contested in court. If the extensive material thus collected were available to the examiner, he would not come to a decision different from that of the Court.

If by the introduction of two different grades of patent the standard of inventiveness for the upper grade were to be raised, the difficulty of obtaining a U.S. patent on an invention acceptable to the British Patent Office would be increased still further. The requirements of inventiveness for the lower grade of U.S. patents would, on the other hand, probably be well below those of British patents.

The suggested lower-grade U.S. patents would not convey exclusive rights to the patentee, but would entitle him to compensatory relief only. This, again, is nothing original; it is comparable with the state of a British patent endorsed with Licenses of Right under Section 24 of the Patents Act, when the terms, in default of agreement, may be settled by the Comptroller.

Decisions on Team Work

A decision by a lower court *in re Potts v. Coe* (140 F(2d) 470, 60 USPQ 226), seems to be more important for the trend of development of patent policy in the United States than the "Flash of Genius" case mentioned above. In brief, this decision of the C.C.P.A. stated that a discovery which would have amounted to invention, if made by an independent inventor, is not to be considered inventive when made in an organised research laboratory.

This view was not, so far, universally adopted. For example, the decision of a Circuit Court of Appeal *in re Chicago Steel Foundry Co. v. Burnside* (Jan. 20, 1943; 56 USPQ 283, 132 F(2d) 812, CCA 7th), is closely in agreement with the British practice when saying: "Our interest is in the child, not in how or where it was born, or who were its parents . . . whether it came as a flash to the mind . . . or by long painstaking search and experimentation."

The view expressed in *Potts v. Coe* has been incorporated into the agenda, and it is proposed to distinguish between "individual achievement," the protection of which is the aim of the U.S. patent law, and "step-by-step improvement, the result of skill and experimentation in the use of existing knowledge . . . which is not invention." The policy underlying the above case and its inclusion in the agenda is the prevention of a monopoly covering an entire field of industry, by systematic investigation of all possible lines of approach, and their covering by patents. It will be remembered that big industrial concerns, particularly I.G. Farben, and the firms in Allied countries in cartel agreement with the German firm, developed this system of "hedgehog positions," the detrimental economic and political effects of which have been exposed by the U.S. Attorney General since the entry of the United States into the war.

In the British patent system there are safeguards (*see* Section 27 of the Patents Act) against the abuse of monopoly, other than those in the United States. However, even in this country, the problem is now under investigation by the Patents Committee of the Board of Trade.

If the principle of *Potts v. Coe* were adopted in U.S. patent law, this might, of course, affect the U.S. patents of British firms working on lines of organised research. As a matter of fact, many valuable British patents are taken out by industrial firms for developments in design, production, or research made by their staff. The British patent system admits co-applicants as the "true and first inventor or inventors" (Section 1 of the Act), and is therefore more favourable to the protection of team work than the U.S. patent system, according to which the inventors only, and nobody else, may apply for a patent, which can, of course, be assigned. This is the rule with inventions made by "captive inventors," as employees of industrial research laboratories are called in the United States.

British would-be patentees of U.S. patents will be well advised to adopt, with a view to "exporting" their inventions to the United States, a method of drafting their British patent applications in a way complying with the new American practice. This means, *inter alia*, drafting the principal claims in such a manner that each of them covers clearly the invention of a sole inventor, or of one of several inventors, or the joint invention of several such individuals, but not any anonymous team work. The latter may, of course, be covered by other claims for "home consumption," which would not then be incorporated into a corresponding U.S. patent application. This would mean an extra burden on the patent agent and on the industrial staff who furnish him with the necessary information, but probably the British patents, too, would benefit from such clear-cut claims.

True and Spurious Inventions

Great inventions of free-lance inventors are few and far between in every country. The natural consequence of commercial exploitation of pioneer inventions is the formation of a research department for their development, and a series of patent applications, which is just what the trend of American patent policy intends to curb.

There are, of course, many inventions of free-lance inventors of a standard comparing with that of the average development work done by employed inventors, and there is also quite a number of "spurious inventions," the offspring of imagination un-

fettered by skill or knowledge. The latter are comparatively harmless under the British patent system, as they seldom survive the end of the fourth year, when the first renewal fee becomes due. In the United States, however, a patent lasts 17 years from the date when it is granted, without any renewal fees, and consequently such spurious patents may become a nuisance.

Other Proposed Reforms

Other reform proposals are, as stated above, more or less adoptions of provisions that have been in force in this country, or elsewhere in Europe, for quite a long time. For example, a petition for revocation of a patent may be presented in this country by the Attorney General himself or by any person authorised by him, under Section 25 (4a) of the Act. Such authorisation (the *fiat*) will be given to any person, who proves a reasonable *bona fide* interest, such as the intention to take up manufacture on lines blocked by a patent he considers invalid. It is now proposed to introduce official action against a granted patent, and action by a petitioner for the revocation of a patent outside the customary defence against an action for infringement, into the U.S. system.

This would be similar to the above-mentioned section of the British patent law and would go beyond the practice of the Central European patent systems, where a patent stood as it was granted by the Patent Office, unless attacked by a petition for revocation. Then the Court or the Department of Nullity of the Patent Office could go beyond the petition and restrict or invalidate the patent on grounds different from those brought forward by the petitioner. Similar powers are suggested in the U.S. proposals, but they seem to be covered by the more far-reaching suggestions mentioned.

It is not to be anticipated that, by the adoption of any of these reform proposals, the interests of British patentees of U.S. patents would be materially affected.

Summary

The agenda of the Committee on the Patent System in the United States should be considered against the background of previous Committee Reports, and of some leading cases of which *Potts v. Coe* (Individual Achievement *versus* Step-by-Step Development) seems to be even more important than the famous "Flash of Genius" case, *Cuno v. Automatic*. The prevention of abuse of monopoly is the guiding principle of the reform proposals, many of which involve adoption of British or Continental European practice into the U.S. patent system. British patent interests may be affected by the restraining attitude towards organised research patents.

A Valuable Record

I.C.S. Chemical Engineering Journal

THE Imperial College Chemical Engineering Society is to be congratulated upon their venture in producing a very creditable résumé* of the addresses given to the Society during the past year. We can always rely on Mr. M. B. Donald, the president of the Society, in infuse enthusiasm into whatever he undertakes, and we suspect that he has had a great deal to do with this publication. The book is well bound and is printed on good paper, a point for congratulation under present conditions.

Sir A. Egerton's Review

Not the least interesting of its contents is the review by Professor Sir Alfred Egerton of the war-time work of the Department of Chemical Engineering and Applied Chemistry, no mean measure of what the nation owes to its scientific workers. It was at first decided to break up the Chemical Engineering Department on the outbreak of war; the teaching staff were to be transferred to Edinburgh and all research work would have been shut down, with complete abandonment of post-graduate work. It happened, however, that one or two investigations on hand were of interest to the Ministry of Supply and to the Services. This, fortunately, reprieved the Department; by December, 1939, the D.S.I.R. had decided to finance the methane liquefaction research, and all idea of moving elsewhere was abandoned; and by April, 1939, the Department had three research groups in action.

Among the investigations described were the preparation of ethylene oxide, the solvent extraction of methane from gases, work on the utilisation of liquid methane as an alternative fuel to petrol, the investigation by electron diffraction technique of the causes of wear in aero engines, the bonding of rubber to metals, and lubrication. A good deal of work was done on fire prevention and on operation "Fido." R. P. Fraser's group was engaged (among other things) with the activities of the Petroleum Warfare Department. The inquiry into heating and ventilating on behalf of the D.S.I.R. and the Ministry of Works has occupied a great deal of time, and the blast furnace group under Dr. H. L. Saunders has carried on steadily through the war.

The workshop staff is to be congratulated on making the equipment needed for the experimental work. Professor Egerton recalls a case "when six rather complicated instruments were needed in six weeks to tide over a six months' interval between the

* *Journal of the Imperial College Chemical Engineering Society*, 1945, Vol. 1, Pp. 78. 5s. 0d. (Copies obtainable from Mr. E. T. Moss, Chemical Engineering Department, Chemical Technology Building, Prince Consort Road, London, S.W.7.)

single experimental model and the production job. We were able to do this for the Ministry of Aircraft Production with, I understand, highly important consequences."

The varied lectures delivered by outside experts which are summarised in this publication comprise such subjects as the Fischer-Tropsch process, accident prevention in the chemical industry, chemical engineering in the plastics industry, investigation of the drying of solid granular materials, industrial flow measurement, the gas industry, radiant and high-frequency heating, etc.

In offering our congratulations to the Society on its enterprise, mention may be made that the Editor, Mr. E. T. Moss, is the recipient of the Hinchley Bronze Medal for 1945 of the Institution of Chemical Engineers. The virile character of the Department makes it particularly gratifying that (to quote from Sir Alfred Egerton's review) "Messrs. Courtaulds have appreciated the importance of the Department in relation to the future of the chemical industry by their generous gift of rather more than £100,000 towards the establishment of a Chair in Chemical Engineering."

New Disinfectants

A Critique of Testing Methods

by P. W. BRIAN, M.A., Ph.D.

A RECENTLY-ISSUED pamphlet* reprints two papers first published in 1943. The first describes two new disinfectants of the substituted phenol type, developed by Givaudan-Delawanna. These substances, G-4 (2,2'-dihydroxy-5,5'-dichlorodiphenyl-methane) and G-11 (2,2'-dihydroxy-3,5,6-3',5',6'-hexachloro - diphenyl - methane), are both highly active against *Staphylococcus aureus*, having phenol coefficients at 37° C. of about 125 and 146 respectively, but G-4 is much the more active against *Salmonella typhi*, having a phenol coefficient at 37° C. of about 105 as compared with about 20 for G-11. G-4 is claimed to be relatively non-toxic and non-irritant, though no data are given, and because of this and its high all-round bactericidal efficiency may well be of use in formulation of household disinfectants. Among the immense variety of substituted phenols, it seems most probable that there will be many that will have properties in every way as desirable as those of G-4, since recent evidence indicates that the mode of action of all phenols is similar and relatively non-specific. It will be of interest, nevertheless, to see whether this substance does become of practical importance.

The second paper discusses aspects of the technique of evaluating bactericides. The author finds, in common with many other workers, that using the standard (F.D.A.) method for estimating phenol coefficients, wide variations in the coefficient found occur in replicate experiments, so that it is not possible, as the author puts it, to obtain "a specific numerical coefficient figure for a definite strength of solution being tested." It seems to the present writer that this is, in any case, an ideal that cannot be achieved, though the degree of variation might be reduced by suitable methods.

It is of interest to consider one of the factors responsible for the variability of results reported in this paper in relation to technique. The individual bacterial cells in a given population vary in their susceptibility to a bactericide. The curve relating mortality to concentration of bactericide is of the usual sigmoid type representing an integrated frequency distribution. If one is comparing two bactericides one might, for instance, compare them on the basis of the concentrations required to cause 50 per cent. mortality (LD 50), that is, the concentrations required to kill an "average" cell, or on the basis of the concentrations causing complete mortality (LD 100). It is the LD 100 that is usually observed in bactericidal assays, and it has certain very considerable theoretical disadvantages, though it is technically easier to devise experimental methods for its determination than for determination of LD 50. The disadvantages arise from the fact that one is determining by this method the concentration of bactericides that will kill a relatively very small number of abnormally resistant cells, and that because of their small numbers sampling errors are greatly magnified. The author of the paper is correct in seeing in sampling errors one of the main causes of the variation he describes, but has not apparently realised the extent to which the information collected by the technique adopted in such tests is responsible for the magnitude of the variations.

The shortcomings of standard methods of evaluating bactericides have been amply demonstrated in this paper and by many other workers. The time is now ripe for the introduction of standard methods based on a much more modern statistical approach. The methods recently devised by Martin (*J. Soc. Chem. Ind.*, 1943, *62*, 67) for evaluation of fungicides provide an excellent example, in another field, of what is possible.

* A. R. CADE, *New Disinfectants and a Critique of Methods of Testing Phenol Coefficients*. New York: Givaudan-Delawanna, Inc. (pp. 8).

SAFETY FIRST

Safety Advice Without Prejudice

by JOHN CREEVEY

IF every man assisting in the operation of a particular type of plant was perfectly familiar with it, the incidence of accidents would be much reduced. And when I say "familiar," I mean familiar in a conscientious sense, for the ordinary degree of familiarity often breeds a certain contempt for minor precautions. Even when special care is given to the choosing of personnel, with an eye on the right man for a particular job in plant operation, or in mere matters of auxiliary attendance upon the operation of plant, there is still no real assurance that accidents will never occur. Apart from such instruction as may be needful for the proper working of a process, there must be definite advice in safety matters, and that advice must be forthcoming from someone competent to give it. It is only when possible hazards are fully recognised that plant can be operated with that degree of safety which is perfectly assuring to the mind.

Yet, while accidents which are peculiar to certain chemical plant features, and the hazards of a process, may be reduced to a minimum—and often entirely eliminated—by correct technique in operation, it does not follow that the common accident arising from mere personal carelessness will occur any less frequently. For avoiding the common accidents, such as those arising from the splashing of acid or the slipping off a ladder, there must be proper mind-training. This is effectively done by displaying suitable posters at the works, while the management must keep watch for the man who is habitually negligent and transfer him to a different job.

Intermittent Contacts

Let it also be remembered that safety affects not only those directly engaged in attending a certain unit operation; there are persons in the works who may contact plant and process intermittently, *e.g.*, the maintenance man, and there are yet others whose safety may be indirectly dependent on safety precautions, *e.g.*, where material flows from one unit operation to another and a break in the continuity of flow may give rise to unforeseen circumstances.

As regards safe operation of a particular plant unit, much good advice may be obtained from the maker of the plant, if that advice is definitely sought. Hazards do exist and accidents do happen, however safe the plant, and the plant maker is often in the position to know of the experience of other users and can offer good operating advice which will prevent a recurrence of the hazardous circumstances.

It is not only in the actual operation of individual types of plant, however, that the root of troubles giving rise to accidents is always to be sought. Plant for a particular unit operation, as designed and supplied by the maker, invariably shows that much attention has been given to various questions of common safety, considered apart from mere safe operation. The plant maker does this for the common good as well as for his reputation, for most certainly he does not want his name constantly recalled in connection with plant accidents, even when those accidents arise wholly by negligence on the part of personnel. Moreover, there are certain requirements of the law which demand—perhaps indirectly—that safety features be incorporated into plant design, although I do not think the obligation is laid direct upon the maker of the plant, save in exceptional cases. The law merely comes into effect when the plant is installed, for then it is that the user must see that statutory precautions are observed for the general safety of those persons who will have to operate or attend that type of plant, or who may come into contact with it in the course of other duties.

Care in Installation

As supplied by the maker, plant for a certain unit operation may be free from all operating hazards; it is often on installation that hazards come into prominence, or are made possible. Most careful attention should therefore be given to the position in which a new piece of plant is to be installed. Process needs may call for a particular situation in the scheme of things, yet often it may be found that the situation preferred for this reason can offer hazards which are not fully realised until after the plant is installed. Those in authority at the works should take this matter seriously in mind before deciding finally upon what seems to be a desirable situation according to flow-sheet or from considerations of available space.

In many instances the available space may be adequate for operation, and yet cramped from the point of view of maintenance. Good maintenance is essential for the efficient operation of any piece of chemical plant, especially where there are moving parts, or pipelines and valves, or auxiliary features such as pumps and electric motors. Furthermore, upon good maintenance rests a certain degree of assurance of freedom

from accident. Therefore, it is eminently wise, when a new piece of plant is being installed, to remember that maintenance *must* be considered and must be made as easy as possible. Positions which are difficult of access do tend to discourage good maintenance; perhaps it is better to say that they irritate the maintenance man, who in turn is liable to get a little less conscientious in his work. I do not say that this is invariably so, but there is some tendency for such a state of affairs to occur; the maintenance man is human and not a robot.

Good installation, too, demands attention to all such things as are likely to present hazardous conditions. Working platforms must be adequate in size for the task to be performed, not forgetting that in some cases it may be necessary for two men to use a certain platform at the same time, although their respective duties may differ. Tripping and falling are common accidents, and there must be protection against them; likewise against objects falling from a platform, for a falling object is dangerous not only to persons who may be passing below, but may also cause injury to plant situated below and that injury may pass unnoticed for some time.

Design of Railings

Railings to platforms should be 42 in. high, with an intermediate rail half way between the top rail and the floor level of the platform. Moreover, such railings must have adequate strength; if constructed of pipe, which is preferable, the pipe should be at least 1¼ in. in diameter; if metal bar, equivalent to angle-iron 1½ in. by 1½ in. by 3/16 in. Toe-boards, which serve a two-fold purpose, one of which is the prevention of objects falling from an overhead platform, should be at least 3 in. high; in some cases, preferably 6 in.; if constructed of metal grille, the mesh should not exceed 1 in. Many such details could be mentioned; these are given to show that there are certain recognised standards of strength even in such minor plant features. The degree of artificial illumination measured at the edge of any platform, and especially at the threshold of stairway and platform, should never be less than one foot-candle; this is approximately that provided by a 60-watt plain glass metallic filament bulb placed 8 ft. from the edge where the illumination is measured.

Where moving parts are a feature of the plant unit, the safety aspects of mechanical power transmission must be recognised. In this there are small details, apart from the standard of good practice, such as the need for all shafting to run without excessive whipping or vibration, and for exposed shafting less than 6 ft. 6 in. from floor level to be guarded. The exposed ends of a shaft should never project beyond the bearing or hub for a distance exceeding half the diameter of that shaft, unless the free ends are guarded by non-rotating caps or safety sleeves. Those who wish to learn about the safe features of various aspects of power transmission by shafting, pulleys, and geared wheels, should visit the Home Office Industrial Museum in London. Accidents are most wisely avoided before they occur; experience may be costly in matter of compensation for injury by moving machinery. Even the guarding of hand-operated gears, used to adjust machine parts and moving only under hand power, is certainly recommended.

Protecting Instruments

Indicating and recording instruments, as well as personnel, demand protection; and adequate lighting is essential for the accuracy of reading them. Yet apart from instruments being in ill-lit positions, I have also observed them in positions inconvenient to reach, and in places with little or no protection against injury from a falling spanner. These things do not enhance the general safety of chemical plant, when such instruments are used as a means of control. Observation windows, too, might much more often be usefully provided in the covers of closed reaction vessels. The extra expense is often justified, apart from the needs of a particular reaction, because a vessel so equipped is adaptable for other uses. Such windows must be in pairs, one for observation by the aid of artificial light entering through the other. In the case of reflux passing back to a still, it is admitted that the amount of this may be known from the quantity and the temperature-rise of the water passing through the reflux condenser, but it is much more convenient to keep this under visual control by aid of an observation window. So, too, glass pipe may be usefully installed at certain points for observation purposes, especially as glass pipe is no longer a novelty but a sound engineering material for chemical plant construction.

In almost every non-ferrous metal, consumption in the third quarter of 1945 was below previous levels, copper showing a decline to 65,244 tons, as compared with 72,378 and 81,103 tons in the second and first quarters respectively, while zinc fell from 43,109 in the April-June quarter to 40,290 tons in the third quarter.

Brief particulars of machines covering a wide field in the production of composite and tin containers, strawboard tubes, cores, etc., have been issued, in the form of an illustrated leaflet, by PERKIN & CO., LTD., Junction Works, Leeds, 12. A further range of machines is stated to be in course of design and construction.

Synthesis of Free Formic Acid

From Carbon Monoxide and Water*

IT is known that the decomposition of formic acid occurs with the formation of carbon monoxide and water, or of carbon dioxide and hydrogen, according to the catalyst used:

$$CO + H_2O \rightleftarrows HCOOH \rightleftarrows CO_2 + H_2.$$

Sabatier and Mailhe[1] as well as other research workers in this field[2] have shown that the decomposition to carbon dioxide and hydrogen, in the presence of catalysts of the platinum group, is initiated at 110°C., at 190°C. in the presence of copper, and at 280°C. in the presence of iron, while the formation of carbon monoxide and water is occasioned in the presence of water-splitting compounds, such as sulphuric acid.

The formation of formic acid from carbon dioxide and hydrogen, at increased pressures, was achieved by F. Fischer and Prziza[3] electro-chemically, and by Bredig and Carter[4] by catalysis.

The formation of formic acid from carbon monoxide and water, which in addition to many other reactions, had already been achieved by Losanitsch and Jovitschitsch[5] in 1897, employing a non-luminous electric discharge, was also studied by Wieland,[6] who established the viewpoint that the conversion of carbon monoxide and water to carbon dioxide and hydrogen proceeded with the intermediate formation of formic acid. It is natural that under the reaction conditions applied at that time, only very small amounts of formic acid were obtained.

Sodium Formate Process

The technical process for the manufacture of formic acid is, as is well known, by way of sodium formate, by the action of carbon monoxide on caustic soda. If carbon monoxide, at a pressure of a few atmospheres, for example, of 5-8 atmospheres, is allowed to act on caustic soda at a temperature of 100°-200°C., both components react according to the following equation: $NaOH + CO = HCOONa$. The sodium formate, after dilution with 90 per cent. formic acid, may be decomposed with sulphuric acid in stages, while the free formic acid is distilled off in a vacuum.

In 1922, F. Fischer and von Philippovich[7] used in place of caustic soda the alkali-reacting disodium phosphate for the production of formic acid. At a temperature of 200°C. and with a carbon monoxide pressure of 20 atmospheres, 46 per cent. of the sodium of a *N* disodium hydrogen phosphate solution was used for the production of sodium formate and of acid phosphate. After completion of the reaction, the easily volatile formic acid could be recovered by distillation, with re-formation of the di-sodium phosphate.

Various experiments were made to prepare free formic acid by the reaction of carbon monoxide and water under pressure. F. Fischer and Schrader[8] obtained a reaction product in 1921, at temperatures of 300°-400°C. and at pressures up to about 135 atmospheres, employing a copper-lined pressure vessel, which consisted of somewhat less than 0.1 *N* formic acid. Ipatieff[9] obtained similar formic acid concentrations in 1928, employing carbon monoxide pressures of 20-100 atmospheres, temperatures of 160°-220° C. and using a copper sulphate solution as a catalyst.

Du Pont and I.C.I. Patents

Information on the formation of higher concentrations of formic acid can only be found in the patent literature, in various specifications, among which may be mentioned those of the Commercial Solvay Corporation,[10] of the Du Pont Company,[11] and of Imperial Chemical Industries.[12] The examples given in the patents originating from the Du Pont Company during the years 1931-1933, are concerned with pressures of about 700 atmospheres and temperatures of 325°C.

The condition is emphasised that the water should be passed over the catalyst in vapour form. The most varied compounds are used as catalysts, such as halogen compounds of alkalis and alkaline earths, phosphates on active carbon, non-volatile acid-forming elements of various groups of the periodic system, chlorine, hydrogen chloride, hydrogen iodide, etc. An I.C.I. patent, originating in the year 1934, makes use of similar catalysts, but employs pressures of more than 200 atmospheres. At 3000 atmospheres, a reaction product was obtained which had a composition of more than half of formic acid.

The work described here was undertaken under the direction of F. Fischer, as a continuation of his previously mentioned fundamental work on the synthesis of formic acid. The dependence of the reaction $CO + H_2O = HCOOH$ on pressure, on temperature, and on various catalysts, was investigated and a clarification was obtained regarding the degree of the formic acid concentration

* Extracted from a paper by H. Pichler and H. Buffleb, of the Kaiser Wilhelm Institut fuer Kohlenforschung, Muelheim-Ruhr, *Brennstoff-Chemie*, 1942, 23, 73.

which could be attained by the reaction conditions investigated.

Experimental Work

The apparatus used for the investigations, consisted of a high-pressure vessel, having a volume of 95 c.c., lined with copper to afford protection against carbon monoxide, and provided with a carbon-monoxide-tight pressure gauge. The autoclave was held in an electrically heated shaking equipment, arranged to operate at a definite speed.

Water and acids, or solutions of salts and carbon monoxide, were used as the starting materials, which were brought to the required pressure by means of a compressor, generally to an initial pressure of 1000 atmospheres. As the PV value rises with increasing pressure, the pressure vessel then contained about half of the carbon monoxide which could be expected according to the ideal gas laws. After filling, the shaking apparatus was set in motion and the autoclave heated to the desired temperature. The rapidity of heating was in all cases the same. The investigation temperature was maintained at a constant figure by means of a control. At the termination of the investigation, the autoclave was cooled as quickly as possible with water in order to prevent an undesirable post-reactions.

After cooling and releasing the pressure of the carbon monoxide, the product obtained was removed from the reaction vessel and tested for the content of formic acid, using the oxidation test with potassium permanganate (Jones' test), a test also being made for the determination of the acidity. Graphical plotting of the pressure increase and decrease, respectively, which occurred during the investigation, and the determination of the gas composition, served as a control.

(a) *Investigations without the addition of catalysts.*—The course of the reaction $CO + H_2O = HCOOH$ was first investigated in the copper-lined pressure vessel without catalysts. For this purpose, 25 c.c. of water were charged in and sufficient carbon monoxide compressed, so that at the required temperature a pressure of about 1500 atmospheres was obtained. The investigations were carried out at 150°, 180°, and at 300°C., and the results appear in Table 1. From the figures given, it will be seen that only a small conversion of carbon monoxide and water to formic acid has occurred. The amount formed was somewhat higher at a lower temperature than at a higher one. In the most favourable case, a reaction product was obtained which consisted of 0.8 *N* formic acid. The carbon monoxide used for the investigations contained 1-1.5 per cent. of hydrogen and small amounts of nitrogen. The reaction gas of the experiment conducted at 150°C. contained 0.2 per cent. CO_2, and 1.3 per cent. H_2, and the gas obtained at 300°C. contained 10.4 per cent. CO_2, and 12.3 per cent. H_2.

(b) *The Formation of Formic Acid in the Presence of Catalysts.*—In Table 2 are collected the results of various experiments, at which carbon monoxide was reacted at 1300-1500 atmospheres and 180°C. with aqueous solutions of certain salts (experiments 1-5) and with water in the presence of oxides (experiments 6 and 7). For each test, 25 c.c. of liquid was used. The results obtained, which are expressed in terms of normality, cover the formic-acid water mixture. The tests were always terminated only after the pressure no longer fell over a period, which indicated that carbon monoxide was no longer being used for formation of formic acid. In the presence of acid potassium fluoride, a 6.3 *N* formic acid was obtained, and using cupric chloride and cupric sulphate, a 5.1 *N* formic acid solution. (During the investigations, these salts were reduced by the carbon monoxide, so that free acid was formed.) In the case of the ferrous chloride, and of the acid sodium phosphate, the results obtained were similar to those in the case of pure water (*see* Table 1). In the presence of thorium oxide extended on silica gel, and of tungsten oxide, almost no formic acid, or even none at all, was obtained.

Table 3 shows the results of seven experiments in the presence of various free acids. For each test, 25 c.c. of acid were used. The normality of the acids used was varied, as the investigations were undertaken with different series of tests. The boric acid solution gave a 1.3 *N* formic acid, hydrochloric and hydrofluoric acids 3.4, and 3.0 *N* formic acid, respectively, while in the reaction product of the remaining four investigations, the normality of the formic acid (calculated on the formic-acid-water mixture) amounted to 5.4 to 6.1.

(c) *The Question of the Formation of an Equilibrium in the System Carbon Monoxide-Water-Formic Acid.*—In Fig. 1 are shown diagrammatically the pressure changes during an investigation. The

TABLE 1.

Reaction of carbon monoxide and water to formic acid without the addition of a catalyst.

Test No.	*Temperature °C.*	*Pressure atmospheres*	*Duration of test hours*	*Normality of formic acid*
1	150	1,435	6	0.6
2	180	1,495	2	0.8
3	300	1,440	5	0.3

example chosen is the one in which 13 *N* H_3PO_4 is used, being test 7 in Table 3. The abscissa shows the time in hours, and the ordinate gives the pressure in atmospheres. During the heating period, which lasted for an hour, the pressure rises from 1020 to 1580 atmospheres and then during the experiment, for a temperature which remains constant, again falls. For six hours, the temperature remains constant at 1485 atmospheres; the final stage of the reaction has been attained. In order to test this for a further experiment, phosphoric acid, water, and formic acid were previously mixed in such a manner that, calculated on the formic acid-water mixture, a 5.7 *N* formic acid was present. This mixture was heated for 5 hours at 180°C., in the presence of highly compressed carbon monoxide. The initial pressure (at 180°C.) read off, amounted to 1370 atmospheres, and the end pressure was 1405 atmospheres. The normality of the formic acid in the reaction product, with respect to the formic acid-water mixture, was 5.0. Accordingly, at 180°C., and at a pressure of 1400 atmospheres, and considering the agreement of the formic acid concentration of this test with the results of the experiments 1 to 3 in Table 2, and with those of tests 4 to 7 in Table 3, equilibrium conditions obtain, in which a 5-6 *N* formic acid is present.

(d) *Influence of the Concentration of the Acids used as Catalysts on the Rapidity of the Formation of Equilibrium Conditions.*— In Table 4, three experiments are presented which were conducted at a temperature of 225°C., and at an experimental pressure of 1453 to 1495 atmospheres, with different concentrations of phosphoric acid. In test 1, the experiment was conducted with 1.5 *N* phosphoric acid. The fall in pressure had ceased after 55 hours, with the use of 4.4 *N* phosphoric acid it ceased after 1¼ hours, and with 13.6 phosphoric acid after 10 minutes. The normality of the formic acid obtained (calculated on the formic acid-water mixture), amounted to 3.6, 3.8, and 3.3 respectively. The constant formic acid concentrations which were obtained in equilibrium at a temperature of 225°C., in the presence of 1.5 to 13.6 N phosphoric acid, after varying times of reaction, are again the same (within the working limitations of the test conditions). As with these three tests, where the same amounts of liquids were used, the amount of the formic acid formed falls in corresponding amount in grs. with increasing concentration of the catalyst. In the case of test 1, 4.24 grs. of formic acid were formed, the amount for test 2 being 4.25 grs., and for test 3, 3.12 grs.

If the phosphoric acid concentration is again increased, and a 30 *N* acid is used, then at 1500 atmospheres, a 2.3 *N* formic acid is obtained. However, the possible formic acid concentration which is obtainable in the presence of dilute phosphoric acid can no longer be obtained here. The phosphoric acid, which is in too concentrated a form, acts in a decomposing manner on the formic acid. A similar effect was observed when sulphuric acid was used as a catalyst. At first, the speed of formation of the formic acid rises with increasing concentration; for a given temperature and pressure, the same amount of formic acid is always formed, until finally, with the use of too concentrated a sulphuric acid, a decomposition occurs, characterised by the moving of the equilibrium towards lower values of formic acid. In the case of phos-

TABLE 2.

Formation of formic acid at 180° C. and about 1300–1500 atmospheres in the presence of various salts and oxides.

Test No.	*Catalyst*	*Temp. °C.*	*Final test pressure—atmospheres at reaction temp.*	*Duration of test hours*	*Normality of formic acid*
1	5 *N* KHF_2	180	1340	5	6.3
2	2 *N* $CuCl_2$	180	1310	7	5.1
3	2 *N* $CuSO_4$	180	1430	15½	5.1
4	7 *N* $FeCl_3$	180	1470	5	0.7
5	11 *N* NaH_2PO_4	180	1500	5	0.5
6	0 grms. ThO_2 and 25 cc. Sil./gel.	180	1380	5	0.2
7	10 grms. WO_3	180	1555	5	0.0

TABLE 3.

Formation of formic acid at 180° C. and about 1350–1500 atmospheres in the presence of various acids.

Test No.	*Catalyst*	*Temp. °C.*	*Final test pressure—atmospheres at reaction temp.*	*Duration of test hours*	*Normality of formic acid*
1	4 *N* H_3BO_3	180	1415	3	1.3
2	12 *N* HCl	180	1385	2	3.4
3	5 *N* HF	180	1475	5	3.0
4	5.4 *N* H_2SiF_6	180	1415	6	5.4
5	9.2 *N* HBF_4	180	1410	1½	5.7
6	5 *N* H_2SO_4	180	1350	3½	6.1
7	13 *N* H_3PO_4	180	1485	5	5.6

phoric acid, the highest reaction velocity, with the formation of the maximum yields of formic acid was obtained with a 13.6 *N* acid, and in the case of sulphuric acid, with a 5 *N* acid; it was found that the 5 *N* sulphuric acid accelerated the reaction more sharply than the 13 *N* phosphoric acid. The shaking of the autoclave was found to be without influence on the reaction speed.

(e) *Dependence of the Temperature on the Formation of Formic Acid.*—In test 7 of Table 3, a 5.6 *N* formic acid was produced in 5 hours, using a 13 *N* phosphoric acid, at a temperature of 180°C., and with an end pressure of 1485 atmospheres. As at lower temperatures, with the use of a 13 *N* phosphoric acid, the reaction time was too long; however, as concentrated phosphoric acid could not be used, the tests shown in Table 5 were conducted with 5 *N* sulphuric acid. In test 1, with 5 *N* sulphuric acid at 180°C., and a final pressure of 1350 atmospheres, a 6.1 *N* formic acid

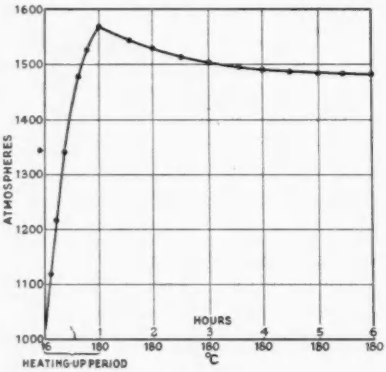


Fig. 1.

was obtained in 3 hours; in test 2, with 5 N. sulphuric acid at 160°C., and 1375 atmospheres, a 7.5 *N* formic acid was obtained in 5 hours. In tests 3 and 4, an attempt was made to increase the speed of the reaction by increasing the surface area of the reaction vessel (by the addition of copper wire netting or copper powder, respectively). Tests 2, 3, and 4, however, with equivalent reaction time and yields, showed the same results. Test 5 was conducted with 5 *N* sulphuric acid at 140°C. The time of test amounted to 24 hours; an 8.9 *N* formic acid was obtained. Test 6 was intended to show the concentration of formic acid which could be obtained at 130°C. To shorten the time of reaction, the test was begun at 190°C., and the temperature was then gradually lowered to 130°C. The total test time amounted to 22 hours. At 130°C., the speed of the reaction, however, was so small that no com-

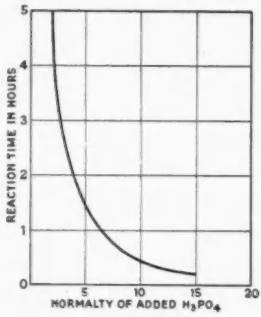


Fig. 2.

plete equilibrium could be attained in this time. The normality of the formic acid obtained amounted to 9.3.

In Fig. 3 is shown the dependence of the formic acid concentration which can be obtained, on the temperature, at pressures of 1400±100 atmospheres. For example, the curve shows that at 150°C. a formic acid concentration which is three times greater than that at 250°C. is obtained. Because of the incomplete attainment of equilibrium the test points obtained at 130° and 140°C. lie somewhat below the curve, while the point obtained at 267°C. lies somewhat above. At this temperature, the reaction proceeded so quickly, that a reversible reaction could not be prevented during the cooling period. Consequently, the point actually corresponds to a temperature some degrees lower.

(f) *Influence of the Pressure of the Carbon Monoxide.*—In Fig. 4 and Table 6 are shown the relation of the formation of the formic acid, on the pressure, at 140°, 160°, 180° and 225°C., respectively. The reaction at 180°C. was investigated in great

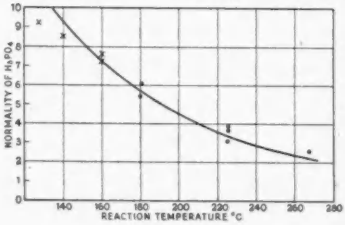


Fig. 3.

detail. The points obtained at different pressures in the region investigated were linear, commencing with zero concentration

at atmospheric pressure. (The 2200 atmospheres pressure given, with a 7.6 *N* formic acid, was obtained by calculation from the initial pressure at room temperature.) The diagram shows the increase of the formic acid concentration with increasing pressure and with falling temperature. At a pressure of 100 atmospheres, the normality of the formic acid in the whole temperature range amounts to less than 0.5; at 160°C. and 1000 atmospheres, it amounts to 5-6; at 160°C. and 1500 atmospheres, to about 8, and at 160°C. and 2000 atmospheres, to 11. This corresponds to a formic-acid/water mixture, containing about 46 per cent. of formic acid. An evaluation of the test results for higher pressures of carbon monoxide, shows that it is possible, at 160°C., to obtain considerably higher concentrations of formic acid. At 180°C. and over, this temperature can naturally only be obtained by extremely high pressures.

If commercial water gas is used in place of pure carbon monoxide for the formic acid synthesis, the course of the reaction corresponds to the partial pressure of the carbon monoxide.

Tests have shown that with the direct action of carbon monoxide on water, in the presence of certain catalysers, high yields of formic acid may be obtained, and that between the concentration of the formic acid in the fluid and the pressure of the carbon monoxide, a certain equilibrium is formed at each temperature. This was reached from both sides of the equilibrium. Mineral acids show themselves to be suitable catalysts, particularly sulphuric acid or phosphoric acid, but also salts, such as copper sulphate, or copper chloride, which were reduced by carbon monoxide under the conditions of the reaction, and the corresponding mineral acids were set free. Optimum concentrations hold for the acids used as catalysts for the formic acid synthesis.

The lower the reaction temperatures are, the higher are the formic acid concentrations which can be obtained with a given carbon dioxide pressure. The optimum temperatures which are required for a sufficiently quick formation of formic acid, lie at 160°-180°C. The use of catalysts which are reasonably fast at low temperatures, would react very favourably on the reaction, as, for example, with a pressure of 2000 atmospheres at 160°C., a formic acid/water mixture is obtained with 46 per cent. of formic acid, while from Fig. 4, at 140°C., a 57 per cent. acid could be expected.

To obtain higher formic acid concentrations, higher carbon monoxide pressures are necessary. In the pressure-temperature region investigated, the formic acid concen-

TABLE 4.
Influence of the concentration of phosphoric acid on the speed of attainment of equilibrium.

Test No.	*Catalyst*	*Temp. °C.*	*Final test pressure at the reaction temp.*	*Duration of reaction hours*	*Normality of formic acid*
1	1.5 N H_3PO_4	225	1453	5	3.6
2	4.4 N H_3PO_4	225	1495	1.75	3.8
3	13.6 N H_3PO_4	225	1470	0.16	3.3

TABLE 5.
Formation of formic acid in the presence of sulphuric acid at various temperatures.

Test No.	*Catalyst*	*Temp. °C.*	*Final test pressure at the reaction temp.*	*Duration of reaction hours*	*Normality of formic acid*
1	5 N H_2SO_4	180	1350	3	6.1
2	5 N H_2SO_4	160	1375	5	7.5
3	5 N H_2SO_4	160	1350	5	7.7
	plus copper wire net				
4	5 N H_2SO_4	160	1420	5	7.4
	plus copper powder				
5	5 N H_2SO_4	140	1280	24	8.9
6	5 N H_2SO_4	from 190 to 130	1330	22	9.3

TABLE 6.
Formation of formic acid at various pressures and various temperatures.

Test No.	*Temp. °C.*	*Pressure atmospheres*	*Catalyst*	*Duration of test hours*	*Normality of formic acid*
1	225	1420	4.4 N H_3PO_4	6	3.8
2	225	1475	4.4 N H_3PO_4	2	3.6
3	225	450	13 N H_3PO_4	1	1.2
4	180	about 2200	13 N H_3PO_4	5	7.6
5	180	1485	13 N H_3PO_4	5	5.6
6	180	755	13 N H_3PO_4	5	2.7
7	180	380	13 N H_3PO_4	5	1.4
8	180	180	13 N H_3PO_4	5	0.6
9	160	about 2000	5 N H_2SO_4	5	10.9
10	160	1375	5 N H_2SO_4	5	7.5
11	140	1280	5 N H_2SO_4	24	8.9

trations rose approximately proportional to the pressure. In Fig. 4, it is shown that at 160°C. and 500 atmospheres, a formic acid about 2.75 *N* was obtained, at 1000 atmospheres, a 5.5 *N* acid, and at 2000

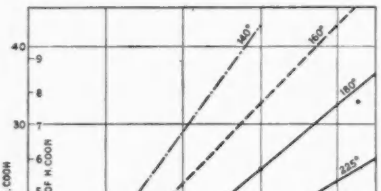


Fig. 4.

atmospheres, an 11 *N* acid (46 per cent. by weight of formic acid). The conclusion may be drawn from this diagram that at still higher carbon monoxide pressures, also appreciably higher formic acid concentrations may be attained. The formation of formate which occurs in the presence of alkalis at lower carbon monoxide pressures, may be attributed to the continuous removal of free formic acid from the equilibrium.

A synthesis from carbon dioxide and hydrogen was only observed from one test, carried out at 300°C. (*see* Table 1). At temperatures below 200°C., thus in the optimum range of the formic acid synthesis, carbon dioxide or other by-products were not obtained in noticeable quantities. The working up of the reaction mixture to concentrated formic acid, may be conducted according to the known methods.

Conclusion

The formation of formic acid by the direct reaction of carbon monoxide on water was investigated at pressures up to 2000 atmospheres. It was established that equilibrium conditions occur with this reaction between the concentration of the formic acid and the pressure of the carbon monoxide. Certain mineral acids and salts, especially sulphuric acid and phosphoric acid, are particularly suitable as catalysts, for the initiation of this equilibrim. The optimum conditions for the formic acid synthesis were determined.

REFERENCES.

[1] SABATIER and MAILHE, *Compt. Rend.*, 1911, *152*, 1212.
[2] ST. CLAIRE-DEVILLE and DEBRAY, *Ber.*, 1874, *7*, 1038; ZELINSKY and GLINKA, *Ber.*, 1911, *44*, 2309; SABATIER, "Die Katalyse," 2nd edition, p. 248.
[3] F. FISCHER and PRIZA, *Ber.*, 1914, *47*, 156.
[4] BREDIG and CARTER, *Ber.*, 1914, *47*, 541; Ger. P. 283,895; 337,503; 339,946.
[5] LOSANITSCH and JOVITSCHITSCH, *Ber.*, 1897, *30*, 135.
[6] WIELAND, *Ber.*, 1912, *45*, 681, 2613.
[7] F. FISCHER and V. PHILIPPOVICH, *Ges. Abh. Kennt. Kohle*, 1923, *6*, 366.
[8] SCHRADER, *Ges. Abh. Kennt. Kohle*, 1923, *6*, 65.
[9] IPATIEFF, *Chim. et Ind.*, 1928, *19*, special number, 411.
[10] Canad. P., 266,304; U.S. P., 1740, 140.
[11] U.S. P. 1,895,238; 1,924,769; 1,949,825; 1,991,732 2,001,659; 2,023,003; 2,053,233.
[12] B.P. 447,492.

PHOTOELASTIC MODELS

In the course of an interesting lecture to the Scottish Engineering Students' Association at Glasgow on November 7, Mr. A. A. Wells dealt with modern methods applying the technique of photoelasticity to engineering problems. Investigations on the subject date from about 1910, when Coker and Filon in this country and Mesnager in France began their work, culminating in the publication in 1931 of the standard treatise on photoelasticity by the first two authors.

Mr. Wells then dealt with the use of the two polarising filters—the polariser and the analyser—on photoelastic models, to obtain fringe patterns on a screen giving the magnitude of the principal difference and the principal stress directions. Although much improved materials have been found for photoelastic models since the original use of glass—notably cast phenol formaldehyde, which has an optical sensitivity 20 times greater than glass—Mr. Wells emphasised that photoelastic models, like all other experimental methods, can never give a *complete* solution of the conditions existing in a protoype. Their great value lies in the comparative results obtainable.

NEW EQUILIBRIUM DIAGRAM

"The Equilibrium Diagram of the Aluminium-Magnesium System" (by G. V. Raynor, M.A., D.Phil.), is the title of No. 5 in the Institute of Metals Annotated Equilibrium Diagram Series, obtainable from the Institute of Metals, 4 Grosvenor Gardens, S.W.1 (6d. post free).

This latest addition to the series contains (a) the diagram reproduced on a generous scale and based on what is regarded as the most reliable work in each phase field; (b) a table giving all important data connected with the diagram; (c) critical notes; and (d) a list of references. It is announced that Nos. 1 to 4 of the series are still available at the same price.

A CHEMIST'S BOOKSHELF

A DICTIONARY OF METALLOGRAPHY. By R. T. Rolfe, F.R.I.C. London: Chapman and Hall. Pp. 243. 15s.

British metallurgists have long awaited a dictionary of their own subject; and Mr. Rolfe's book can fairly justify its claim to fulfil a long-felt want. Convenience has dictated conciseness in the definitions; and the resultant compact form of the volume is an admirable quality. Those who would have wished for more information must be reminded that this is a dictionary, not an encyclopædia, and they are rightly expected to go elsewhere for full information on matters of detail. It does not appear captious to suggest, however, that some reference to the literature from which more detailed information can be obtained might be included in future editions. Space could be saved for this purpose by omission of definitions of terms which are not specifically metallurgical; for example, the definition of the proton, though admirable in itself, could be sought elsewhere; and there are other general terms of this type which we venture to suggest take up more room than is warranted in a specialised volume of this kind. For instance, is the periodic table really essential?

These criticisms, however, are directed merely towards the perfection of an admirable work. This dictionary should have a place in every works and every laboratory where the properties or the working of metals are a consideration.

THE CHEMICAL MANUFACTURERS' DIRECTORY FOR 1945. London: Simpkin Marshall. Pp. 192. 5s. 6d.

The 77th edition of this valuable work of reference, still at a very low price, is as essential as ever for knowledge of the anatomy of the British chemical industry. A list of classified chemicals, showing the makers of each kind, occupies 70 pages, and is followed by exhaustive lists of chemical manufacturers. We are glad to note that a considerable revision has been made of the products supplied by various manufacturers.

SUNVIC CONTROLS, LTD., Stanhope House, Kean Street, London, W.C.2, have issued a leaflet, No. EA.10(a), giving particulars of their electronic relay, Type EA 2, designed to fulfil the demand for a highly accurate control instrument with light contacts. It is claimed that with the Sunvic Electronic Relay, which needs only a few micro-watts and will control a load of 2 kW at 200/250 volts A.C., troubles from erosion and oxidation of the contact surfaces are avoided. Particulars of construction and operation are included on the leaflet.

Industrial Safety Gleanings

Injury Benefits

THE basic rate for injury benefit and complete disablement benefit under the National Insurance (Industrial Injuries) Bill was raised last week from 40s. to 45s., while the corresponding rate for those under 18 was increased from 20s. to 22s. 6d. The Standing Committee accepted, without a division, amendments covering the above alterations. The Minister for National Insurance (Mr. J. Griffiths) indicated that he proposed to incorporate another improvement in the Bill, by the creation of a special 17-18 juvenile class, who would receive three-quarter benefits.

Methane in the Shipyard

The necessity for seeing that sea-valves should be designed so as to be gas-tight was brought out in the report of Mr. G. G. S. Richardson, H.M. Inspector of Factories, which was read out at an inquiry held recently at Dumbarton Sheriff Court, dealing with the death of three workmen on board H.M.S. *Vanguard* in the fitting-out basin of a Clydebank shipyard.

In Mr. Richardson's report it was stated that tests had proved that leakage of methane was taking place through the sea-valves which were water-tight but evidently not gas-tight. It was known that methane was generated in considerable quantities by the decomposition of organic matter at the bottom of the basin. Some of this gas was being trapped below the ship in the intakes of the sea-valves, finding its way thence into the interior of the ship. While the leakage was very slow, it would be sufficient in time to build up an explosive concentration in a compartment where it was free to diffuse.

The available evidence all pointed to the explosion having been due to the ignition of such an accumulation of methane. The cause of the ignition was not known. Smoking on the ship was officially prohibited, but this order was undoubtedly disobeyed at times. A spark from a hammer or a hob-nailed boot might alternatively have initiated the explosion.

Safety Group Activities

During the coming months, it is hoped that new Industrial Groups of the Royal Society for the prevention of accidents will be organised in Ipswich, Bristol and Bath, and West Cumberland, among other localities. A new group is in process of formation at Halifax. It is expected to hold the inaugural meeting at Ipswich this month. The Swansea group held its first annual general meeting on October 17. After only a year's work here, the average attendance at the monthly meetings is in the region of 35 members, representing 24 different firms.

Parliamentary Topics

Development of Wales

IN the House of Commons last week, the Prime Minister, replying to Mr. D. J. Williams, said that he was not able to make a statement regarding the setting up of an Economic Research Council for Wales.

Synthetic Rubber Manufacture

Asked by Mr. J. Lewis whether any progress had been made in the building of a plant for the manufacture of synthetic rubber under a licence granted to the British Celanese Corporation in 1943, the President of the Board of Trade replied that the company decided not to continue with their original proposals, but to proceed with the erection of a pilot plant.

German Synthetic Oil

Mr. Shinwell, replying to Sir G. Fox, said that the pipeline system known as "PLUTO," had been discontinued and much of the equipment had already been removed. None of the German synthetic oil plants in the British zone were working and accordingly supplies of petrol from Germany were not available.

Smoke-Reducing Appliances

Replying to Mr. Gibson, the Minister of Fuel and Power said that the Government was considering the possibilities of smoke-reducing appliances suitable for use with smokeless fuels.

Silicosis Cases (Training)

Mr. D. J. Williams asked the Minister of Labour how many men suffering from silicosis or pneumoconiosis had been admitted to Government training centres; what occupations they had been trained for; and how many of them had been placed in suitable jobs.

The Minister of Labour replying, said that about 80 men suffering from silicosis and pneumoconiosis had recently been placed in two new South Wales factories, where they were being trained mainly as gas and electric welders.

Patent Law Amendment

Major Boyd-Carpenter asked the President of the Board of Trade whether he intended to introduce in the near future any amendment in the patent law.

Sir Stafford Cripps: Steps are being taken to prepare a Bill to implement the recommendations contained in the first interim report of the Swan Committee about the procedure for extension of term of patents in cases where the patentee has suffered loss or damage as a result of the war, and to make other provisions to deal with war circumstances.

Indian Chemical Industry

I.C.M.A. Suggests Mixed Companies

THE formation of mixed Indian-British chemical companies, to bring about both a better diversification of the Indian chemical industry and a better utilisation of her natural wealth and human skill, was the most important suggestion made to a representative of THE CHEMICAL AGE by a delegation of the Indian Chemical Manufacturers' Association, members of which are spending a month in this country to see how the project may be brought nearer to fruition. At the same time, orders for British chemical plant and equipment (no chemical plant is being manufactured at present in India) will be placed. The delegation will then proceed to the United States, whence it will return to this country. Dr. K. A. Hamied, the head of the delegation, gave the assurance that, unless there is a very wide margin between British and United States prices, orders for plant will, by preference, be placed in this country, provided that the time factor is no obstacle.

The Indian Chemical Manufacturers' Association, established nine years ago, has at present some 120 members, accounting for over 90 per cent. of the total output of India. The Association plans to build up a co-operative research laboratory, similar to the world-famous Mellon Institute, which the delegation proposes to study while in the United States. For the establishment of such an organisation—which incidentally is badly required in this country—a sum of two million rupees would be sufficient. Moreover, the Government of India is prepared to contribute half the cost. However, no action can be expected by individual firms until research expenditure can be deducted for income tax purposes.

Remarkable War Effort

As far as production is concerned, India's contribution to victory in the Far and Middle East has not been fully appreciated in this country. There was a remarkable increase in the volume of output of chemicals, but diversity of production and development work on a scientific basis were lacking. There was, for instance, no production of coal-tar derivatives, and no manufacture of solvents nor of organic chemicals. The heavy chemical industry, however, had made great strides.

A closer co-operation between the Indian and the British chemical industries is undoubtedly a project that deserves the most impartial examination and favourable reception. It is to be hoped, therefore, that not only will various technical and financial problems be discussed but that a mutually advantageous solution may be found.

Personal Notes

MR. H. E. CHASTENEY, a deputy chief inspector of factories, has been appointed chief inspector, in succession to SIR WILFRID GARRETT, who will retire in January.

MR. W. F. MARTIN, manager of the liquid resins department of Catalin, Ltd., has joined the Cornelius Chemical Co., Ltd., as sales manager and technical representative.

MR. D. B. WHITFIELD, manager of the Widnes works of Todd Bros. (St. Helens & Widnes), Ltd., steel drum manufacturers, etc., has been appointed a director of the company.

PROFESSOR ROGER ADAMS has been awarded the Davy Medal of the Royal Society for his extensive researches in the field of organic chemistry and his recent work in the alkaloid field.

DR. O. T. AVERY, For.Memb.R.S., has been awarded the Royal Society's Copley Medal for his success in introducing chemical methods in the study of immunity against infective diseases.

PROFESSOR J. D. BERNAL, F.R.S., has been awarded the Royal Medal of the Royal Society for his work on the structure of proteins and other substances by X-ray methods, and on many other problems.

MR. H. B. HILL, who has been manager of the Dyce chemical works of Scottish Agricultural Industries for eight years, has left for Carnoustie. MR. P. MARTIN has now taken over the managership.

DR. W. G. MACMILLAN, F.R.I.C., chief chemist, Indian Jute Mills Research Institute, has been elected a Fellow of the Textile Institute; and MR. R. WALTON, chief chemist, H. Harrison (Finishers), Ltd., Leicester, has been elected an Associate.

MR. ALLAN COLLIER, chief chemist at the British Diesel Oil and Petrol Company, Bolsover, has accepted a new appointment with the Anglo-Iranian Oil Company in London. He joined Low Temperature Carbonisation, Ltd., parent company of British Diesel Oil, in 1936.

DR. A. H. S. HOLBOURN, of Edinburgh, has been granted the first award of the Charles V. Boys Memorial Prize for experimental physics. Dr. Holbourn, who was educated at Edinburgh Academy and Edinburgh University, won the prize for work on the measurement of the angular momentum of polarised light.

MR. G. F. MCKILLOP, A.R.I.C., works manager and chief chemist of Commonwealth Oil Refineries, and formerly chief chemist at the Broxburn works of Scottish Oils, Ltd., has retired after 45 years' service, the last 22 of which were spent with C.O.R., the associated Australian company of the Anglo-Iranian Oil Company.

As indicated in our last week's issue, the chief credit for the development of the new antimalarial, Paludrine, was mainly due to a chemical-biological research team. The members of the team were: DR. F. H. S. CURD, DR. F. L. ROSE, and DR. D. G DAVEY. Dr. Curd, who is a Londoner, was educated at Bancroft's School and London University, and joined I.C.I. in 1933. Before that date he had been researching at the London School of Hygiene and Tropical Medicine. Dr. Rose was born at Lincoln, and was educated at the City School there, and Nottingham University. Joining I.C.I. in 1932, he worked first as a dyestuffs chemist but went over to chemotherapy in 1936. Dr. Davey was educated at the Secondary School at Caerphilly (his native town), at University College, Cardiff, and Cambridge University. He gained a Ministry of Agriculture Research Scholarship to Harvard. He has lectured on zoology at Cambridge and Cardiff and worked with the Ministry of Supply on radiolocation. He joined I.C.I. in 1942.

Obituary

MR. W. RUPERT KING, editor and part proprietor of the *Gas Journal*, died at Esher, Surrey, on November 8, at the age of 54, after some months' illness. He was the elder son of the late Walter King and grandson of W. Broughton King who, in 1849, published the first Journal of Gas Lighting. He held a commission in the Durham Light Infantry in World War I and later joined the staff of the Stella Coal Company. He rejoined the *Gas Journal* office in 1928 and when Alfred Harrison, former editor of the *Gas Journal*, retired in 1936 Rupert King was his natural successor.

DR JAMES FOWLER TOCHER, D.Sc., LL.D., F.R.I.C., who died at Aberdeen on November 8, aged 81, had been consulting chemist to the Highland and Agricultural Society since 1912, and was lecturer in statistics at Aberdeen University in 1911-41. A native of Fyvie, Aberdeenshire, and for some time in business on his own account as a chemist at Peterhead, he was educated at Mason College, Birmingham, University College, London, and Aberdeen University. He had served as public analyst for the County of Aberdeen and for other public authorities in N.E. Scotland, and had been on the governing bodies of the North of Scotland College of Agriculture, the Rowett Research Institute, the Macaulay Institute for Soil Research, and Robert Gordon's College. He also acted as examiner in statistics at the Universities of London and Leeds, as well as for National Diplomas in agriculture and dairying. In 1893 he became a Fellow of the Royal Institute of Chemistry and was on the Council of the Institute in 1924-27.

General News——From Week to Week

S.R. & O. 1945, No. 1354, which is now in force, terminates sub-section 1 of Section 1 of the Czecho-Slovakia (Restrictions on Banking Accounts) Act, 1939.

Walter Reynolds & Son, specialists in the purification of non-ferrous minerals, have removed to Ladbroke House, 70 High Street, Uttoxeter, Staffs.

The Business Reply Card and Envelope Service, which was suspended as a war-time economy measure, will be restored on December 1.

The value of chemicals, drugs, perfumery, dyes and colours imported into Eire in the first nine months of this year amounted to £1,285,318, against £1,084,766 in the same period of 1944.

A new organisation, to assist in the sponsoring and supply to India of plant, machinery and equipment, has been established at 45/47 Mount Street, London, W.1, by the Government of India.

A factory at Thornliebank, Glasgow, which has been allocated to the Mond Nickel Co., Ltd., for the processing of nickel-containing materials, is one of 16 Government factories handed over to civilian production by the Board of Trade last week.

The Minister of Food announces that there will be no change in the existing prices of refined oils and imported edible animal fats allocated to primary wholesalers and large trade users during the eight weeks period November 11, 1945, to January 5, 1946.

The Control of Iron and Steel (No. 43) Order, 1945, which came into force on November 12, increases the price of mild drawn mild steel wire, annealed mild steel wire, galvanised barbed wire, wire netting, and wire rod and wire rod reinforcement mesh (S. R. & O. 1945, No. 1391).

Wholesale prices in October, as measured by the Board of Trade, fell by 0.1 per cent., compared with September, or from 169.6 to 169.4. The same percentage decline was registered for industrial materials and manufactures. The index number for chemicals and oils declined from 147.6 to 147.4, the main changes in this group being a seasonal increase of 1 per cent. for sulphate of ammonia and for superphosphate, and a 5 per cent. fall in the price of sulphuric acid, owing to a reduction of the controlled price. While the index figures for coal, and for iron and steel, remained unchanged at 243.7 and 189.6, there was a fall from 129.3 to 126.9 (1.8 per cent.) in the non-ferrous metals group, due to the pronounced drop of 14 per cent. in the price of brass, which reached the lowest level since the end of 1939.

In memory of Mr. J. S. Ford, F.R.I.C., F.R.S.E., who died last year after 55 years as chief chemist to William Younger & Co., Ltd. (of which company he was a director since 1921), a Trust has been created, under the auspices of the Institute of Brewing, for the purpose of assisting the training of young persons desirous to be brewers. His widow has made the generous donation of £4000 for the purpose of this Trust.

Scottish Oils, Ltd., are to be congratulated on an excellent display in the "Meet Scotland" exhibition in the Royal Scottish Museum, Edinburgh, as part of the fine mining-industry section. The main feature of their display is a large-scale working model of the surface and underground of the West Lothian shale-producing country, cut in section so as to give a clear impression of the methods of mining.

At the inaugural meeting of the Sheffield Industrial Applications Section of the Royal Statistical Society, attended by nearly 100 industrialists, four speakers gave their own practical experiences, illustrating the saving brought about by the application of statistical methods in diverse industries. Mr. Bovill, general manager of the chemical works of Newton, Chambers & Co., proposed formally that the group be formed.

"Food Yeast: A Survey of its Nutritive Value" has been published by H.M.S.O. (price 3d.) as War Memorandum No. 16 of the Medical Research Council. Included in a diet of which the protein is otherwise derived mainly from cereals, the food yeast proteins (equal to about half its dried weight) possess high nutritive value. Taken in small amounts, ½-½ oz. daily, the yeast provides a valuable addition to the B vitamins contained in an ordinary diet.

Seven pages of deletions are the main feature of the Trading with the Enemy (Specified Persons) (Amendment) (No. 11) Order, 1945 (S.R. & O. 1945, No. 1338). Only 18 additions are made to the existing list. The following names among the deletions may be of interest: *Brazil*: Cia. de Acidos S.A., Rio de Janeiro; Fabrica de Tintas Vulcao, S. Paulo; Industria Brasileira de Fios e Artefactos de Metais, Bello Horizonte; Produtos Quimicos, Ltda., "Iba," S. Paulo; Casa Technica Mineira, Bello Horizonte; and Tintas e Produtos Albion, Ltda., Rio de Janeiro; *Portugal*: Cia. Portuguesa de Tungstenio, Lisbon; *Spain*: Anilinas S.A., Barcelona; Soc. Española de Talcos, S.A., León, Madrid and Almeria; Nitratos de Castilla S.A. (Nicas), Bilbao; and Soc. Nacional de Industrias y Aplicaciones de Celulosa Española (S.N.I.A.C.E.), Madrid and Santander.

A young woman engaged at the chemical works of Monsanto Chemicals, Ltd., Ruabon, was awarded damages amounting to £483 by Mr. Justice Hallett at Liverpool Assizes on October 31. When she was working at a revolving pan, a rake fell from another worker's hands into the pan, and struck her. She was badly injured and was in hospital for seven weeks. It was urged for the defence that there had been no failure to produce a safe system; the pans could not be called dangerous machines: and that there was no negligence on the part of the defendants.

Foreign News

All export restrictions on petroleum and petroleum products have been removed since November 1 in the United States. A number of regional distribution committees, including the Near East and Far East Supply and Distribution Committee and the European Petroleum Supply Committee have been discontinued.

The new Swiss trade agreement with Sweden, concluded last month, is expected to lead to a noteworthy increase in the export of Swiss dyes, replacing former German supplies. Swiss manufacturers hope to establish a permanent market before American and British producers will be able to deliver.

The important Solvay soda plant at Rosignano, near Leghorn, which formerly supplied about 80 per cent. of Italy's needs, has been repaired. Production began at the end of May, with a daily output of 200 tons of sodium carbonate, sodium bichromate, and caustic soda, which was scheduled to be increased to 450 tons daily within 3 months.

A foreign concern has submitted an offer to the Budapest municipality for the construction of a pipe-line to feed 8,000,000 cu. metres of natural gas annually from the Lispe oilfields to Hungary's capital. The cost is reported to be $2,000,000, to be met by the company against a concession for the gas supply for 99 years.

Forthcoming Events

November 17. The Institution of Chemical Engineers (North - Western Branch). Reynolds Hall, College of Technology, Manchester, 3 p.m. Mr. L. F. Keeley: "Heat-Resisting Steels."

November 17. International Society of Leather Trades' Chemists (British Section, Manchester Group). Engineers' Club, 17a Albert Square, Manchester, 2 p.m. Mr. A. Cheshire: "A New Method for the Experimental Aging of Leather" (A discussion will be opened by Mr. J. M. Harrison); and Mr. W. R. Atkin: "The Vegetable Tannins."

November 20. Society of Chemical Industry (Food Group). Rooms of the Chemical Society, Burlington House, Piccadilly, London, W.1, 6.30 p.m. Dr. A. Neuberger: "The Nutritional Rôle of Aminoacids."

November 21. Institute of Fuel. Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, 6 p.m. Dr. M. Fishenden and Dr. O. Saunders: "Heat Transmission."

November 21. Royal Institute of Chemistry (London and South-Eastern Counties Section). Pharmaceutical Society, 17 Bloomsbury Square, London, W.C.1, 6 p.m. Annual general meeting.

November 21. Society of Chemical Industry. Royal Institution, Albemarle Street, London, W.1, 6.15 p.m. Sir Harold Hartley, F.R.S.: "The Life and Work of Dr. Armstrong." (First H. E. Armstrong Memorial Lecture.)

November 22-23. British Ceramic Society. (Refractory Materials Section.) Leeds University. A range of papers devoted to refractory clays, silica bricks and statistical testing methods will be read.

November 22-23. Iron and Steel Institute. Autumn General Meeting. Chartered Surveyors' Institution, 12 Great George Street, London, S.W.1. November 22, 10.30 a.m. to 12.45 p.m.: Presentation of a Williams prize to Mr. R. W. Evans. A wide selection of papers on ferrous metallurgy will be presented.

November 23. British Association of Chemists (St. Helens Section). Y.M.C.A. Buildings, 7.30 p.m. Dr. N. Thorley: "Chemical Analysis by X-rays."

November 23. Association of Scientific Workers. Onward Hall, 207 Deansgate, Manchester, 7 p.m. Dr. W. A. Wooster: "Science To-day in the U.S.S.R."

November 23. Bedson Club. Chemistry Theatre, King's College, Newcastle-upon-Tyne, 5.30 p.m. Dr. G. F. Marrian: "Biochemistry of the Corpus Luteum Hormone."

November 23. Chemical Society (South Wales Section), **Royal Institute of Chemistry** and **Society of Chemical Industry.** University College, Cardiff, 6.30 p.m. Professor J. W. Cook: "Colchicine: Its Chemistry and some Biological Effects."

November 24. Institution of Factory Managers. Engineers' Club, Albert Square, Manchester, 2.30 p.m. Mr. J. B. Longmuir (General Welfare Officer, Newton Chambers & Co., Ltd.): "Training for all Levels of Management."

November 26. Society of Chemical Industry (Leeds Section). Chemistry Lecture Theatre, Leeds University, 6.30 p.m. Professor E. D. Hughes: "Substitution" (Tilden Lecture).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an '*— followed by the date of the Summary, but such total may have been reduced.)

ROBERTS, ORME & CO., LTD., Bristol, chemical manufacturers. (M., 17/11/45.) October 11, £6000 debenture, to Branch Nominees, Ltd.; general charge. *Nil. February 19, 1945.

D. HOYLE & CO., LTD., Colne (Lancs), drysalters. (M., 17/11/45.) October 17, charge, to Colne Building Society securing £800 and any other moneys, etc.; charged on West Street Garage, West Street, Colne. *Nil. December 30, 1944.

LUMA PRODUCTS, LTD., London, N., chemical manufacturers. (M., 17/11/45.) October 24, £4000 debentures; general charge. *£2000. February 15, 1944.

Company Winding-Up

PREPAC CHEMICALS, LTD., 23 High Street, Cardiff. (C.W.U., 17/11/45.) Winding-up order—October 15.

New Companies Registered

Elro Products (Lancaster), Ltd. (399,155).—Capital £2000 in £1 shares. Manufacturers of and dealers in rat poison, insecticides, fertilisers, chemicals, etc. Directors: J. H. R. Dixon; W. Rogerson. Registered office: 77a North Road, Lancaster.

British Chemical Digest, Ltd. (399,126).—Private company. Capital, £100 in £1 shares. Publishers, printers, newspaper and magazine proprietors, advertising specialists and agents. Directors: A. Cordes; T. K. Cordes. Registered office: 14 The Avenue, Beckenham.

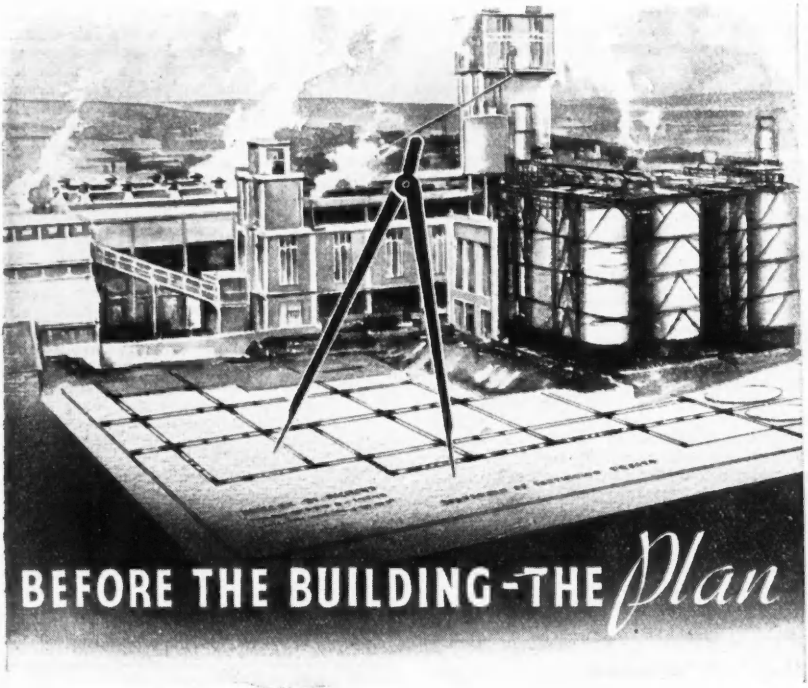
Chemical and Allied Stocks and Shares

BUSINESS in stock markets has been well maintained, although price movements in most sections were small and buying selective. Hopeful views as to the outcome of the Anglo-U.S. talks assisted sentiment, but in some directions nationalisation uncertainties and news of the forthcoming National Investment Board had an unsettling influence. Cable & Wireless (Holding) ordinary and preference stocks advanced strongly, hopeful views prevailing as to the likely terms of acquisition for the operating company. British Funds were active, but less firm, profit-taking being reflected by 2½ per cent. Consols and other long-dated stocks. Movements in industrials were generally small, but dividend hopes and other factors resulted in a number of strong features.

Tube Investments have been prominent, rising to above £6, but later easing to this figure, prevailing market hopes centring on the prospects of either an increase in the forthcoming dividend or of an offer of additional shares to shareholders to provide for the company's programme of expansion in home and export markets. Stewarts & Lloyds were firm at 56s. 7½d. on the bonus proposed by the company's South African subsidiary. On the other hand, Dorman Long eased to 25s. 6d. on the news that the accounts will be delayed pending settlement of important matters with Government departments. Allied Ironfounders at 58s. 6d. lost part of an earlier rise. Powell Duffryn were good at 23s. 9d., it being pointed out that although in due course the colliery interests will be subject to nationalisation, the company has important trading and other interests. In other directions, Radiation at 62s. 6d. continued to be favoured on the lifting of the purchase tax on gas stoves, etc., and Cannon Iron were active around 18s. 9d.

Imperial Chemical eased slightly to 41s., B. Laporte were firm at 87s. xd, W. J. Bush were 78s. 9d., Monsanto-Chemicals 5½ per cent. preference 23s., and Greeff-Chemicals 5s. ordinary 9s. 6d. Fisons were 59s., and Metal Box 98s. 1½d., and there was an upward tendency in paint shares under the lead of Lewis Berger, which further advanced to 119s. 6d. on the possibility of a dividend increase. Turner & Newall at 84s 6d. continued to attract buyers, Distillers showed firmness at 118s. 3d., United Molasses were 43s. 6d., and British Plaster Board active around 36s. Associated Cement further rallied to 60s. 6d. Cellon 5s. ordinary kept at 26s., Burt Boulton moved up to 28s. 9d. xd, while British Glues & Chemicals 4s. ordinary were 12s. 9d., and Gas Light & Coke 23s. 3d. British Aluminium were 40s. 1½d., British Oxygen 87s. 6d., and Triplex Glass 39s. 9d. Wall Paper Manufacturers deferred have been firm at 43s. 3d., Borax Consolidated 44s. 6d., and General Refractories 10s. shares 18s. Movements in textiles were small, Calico Printers being 21s., Bradford Dyers 26s. 10½d., and Bleachers 14s. British Celanese rallied to 33s. 6d. following the sharp fall in price on the dividend "cut" and Courtaulds were good at 58s. 1½d.

Boots Drug eased slightly to 55s. 3d.,



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Sangers were 31s., Timothy Whites 43s. 6d., and Beechams deferred firm at 22s. 3d., while Griffiths Hughes moved up to 45s. Electrical equipments kept generally steady on the industry's good prospects both at home and in export markets. General Electric were 98s., Associated Electrical 59s., Crompton Parkinson 32s., and Brush Electrical 5s. ordinary 10s. 6d. Oils failed to hold an earlier rally, Shell easing to 84s. 4½d., and Ultramar Oil to 73s. Attock Oil fell back to 60s. 7½d. on disappointment with the results.

British Chemical Prices

Market Reports

A FIRM tone continues to be maintained in the London market for general chemicals and reports from nearly all sections indicate a fairly widespread activity. A steady movement into consumption is taking place in most sections and values throughout continue to display a strong tendency. A steady inquiry for fresh business in both home and overseas markets has been reported. In the soda products section a moderate demand is reported for nitrite of soda, while soda ash and bicarbonate of soda are firm. A good demand is circulating for Glauber salt and salt cake, and a moderate demand has again been experienced for both grades of hyposulphite of soda. In the potash section, there is very little yellow prussiate of potash and caustic potash available, and a fair demand is reported for permanganate of potash. Acid phosphate of potash is a good market. In other directions, white powdered arsenic is a good market, and a brisk inquiry is reported for British-made formaldehyde. The position of the coal-tar products remains unaltered since last report.

MANCHESTER.—Both in heavy chemicals and in tar products a fair number of inquiries on export account has been reported on the Manchester market during the past week; actual orders booked have covered a variety of materials and have amounted to a moderate aggregate quantity. Home users have also been in the market again and contract delivery specifications are circulating fairly freely in a wide range of heavy chemicals, including the alkalis and the heavy acids. Makers of the white and red leads report a steady accession to order books. In the tar products, creosote oil, carbolic acid, benzol, and naphthalene are in good demand. Pitch is a steady export section, as are also the general run of light products.

GLASGOW.—In the Scottish heavy chemical trade during the past week business has improved considerably, mainly owing to the resumption of work at the docks. Prices remain firm. Export trade also is more active now that shipping has been resumed.

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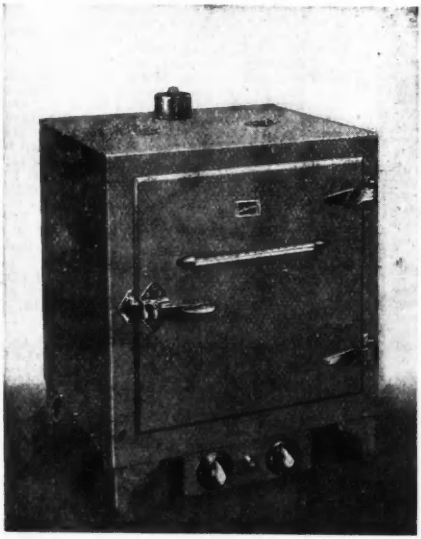
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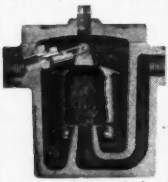
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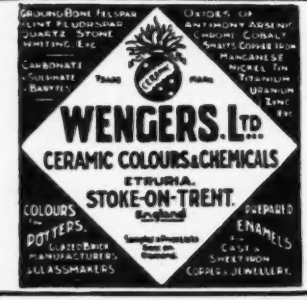


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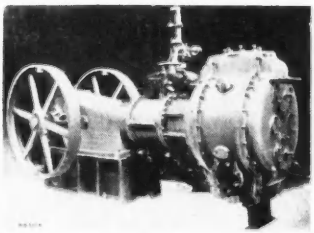
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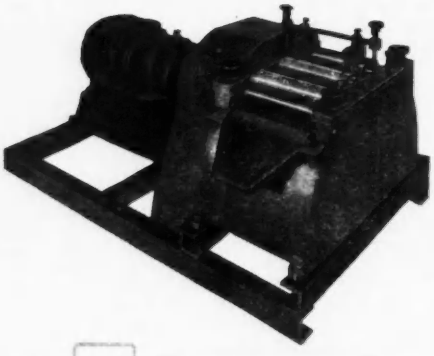
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Printed in Great Britain by THE PRESS AT COOMBELANDS, London and Addlestone, and published by BENN BROTHERS, LTD., at Bouverie House, 154, Fleet Street, E.C.4, November 17th, 1945. Entered as Second Class Matter at the New York, U.S.A., Post Office.



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